



Conserve O Gram

July 1993

Number 3/4

Mold And Mildew: Prevention Of Microorganism Growth In Museum Collections

Mold is the common term used to describe a downy or furry growth on the surface of organic matter, caused by fungi, especially in the presence of dampness and decay. A fungus (pl. fungi) may be any of a large number of microorganisms that are parasites feeding on living organisms or dead organic matter.

Mold is often used interchangeably with the word *mildew*. They are the generic terms that describe a variety of microorganisms, including fungi, algae, rusts, yeasts, and bacteria, that are agents of deterioration for museum objects. They produce irregular stains that can permanently damage an object. Collection managers must be able to recognize signs of these problems and be prepared to take preventive actions.

The Microorganisms

Fungi are simple-celled organisms that do not need energy from light for growth. The fungi bear microscopic spores that are produced in enormous quantities, are always present in the air, and spread via air currents. They are often water repellant and are resistant to desiccation (drying out). Extreme cold and heat will destroy them.

When the spores are in a favorable environment, they will germinate. What constitutes a favorable environment is different for each species. After landing on a host material, a spore must obtain sufficient moisture to germinate and find enough food. Without moisture, the spores will lie dormant until favorable conditions occur.

For this reason, it is important to control the environmental conditions where museum collections are stored or exhibited. The NPS *Museum Handbook*, Part I (Rev 9/90), Chapter 4, recommends that temperatures not exceed 24°C (75°F) and relative humidity (RH) not rise above 65%. These conditions are maximum levels and only reduce the potential for microorganism growth. They do not eliminate the threat. Some microorganisms can grow in significantly lower temperatures and at lower RH levels. Certain materials need to be stored with lower RH levels to prevent growths. Refer to the NPS *Museum Handbook*, Part I (Rev 9/90), Figure 4.3, chart for the RH target levels for various materials and types of objects that are housed in park museum collections.

NOTE: Some species of microorganisms cause health risks in the form of chronic lung irritation. Always exercise caution when handling badly infested materials, i.e. wear a high-efficiency particulate air (HEPA) filter respirator and disposable gloves. (See also *Conserve O Gram* 16/1.)

Susceptible Materials

Microorganisms need organic materials to supply nutrients and, therefore, museum objects composed of organic materials are potentially at risk. Cellulose-based materials, such as cotton, linen, paper and wood, and proteinaceous materials such as leather and hair cloth are particularly susceptible to direct attack by microorganisms.

Inhospitable materials, such as plastics, are not immune from fungal growths but how they

support these growths is not fully understood by biologists. Certain mites feed on fungi and can carry spores onto normally resistant materials. As the mites die, they become the nutrients for a new fungal colony. This ability to exist on almost any material characterizes microorganisms as primary agents of deterioration.

Damage

Microorganisms will permanently damage the materials supporting them. They will stain textiles and decrease the strength of the fabric. The scattered spots known as foxing on paper prints or drawings is damage resulting from these growths. Leather is particularly susceptible to the actions of microorganisms and will be stained and weakened by them. As a by-product, fungi can produce organic acids that will corrode and etch inorganic materials.

Detection

Often the first indication that a microorganism problem exists is a characteristic musty odor. A careful visual examination will generally locate stains that are clearly visible as pigmentations on a surface.

Another means of detection is by the use of ultraviolet (UV) light. Under UV light, a microorganism growth will appear luminescent.

Prevention

The best means to prevent or control the spread of microorganism growth is to deny the spores the moisture necessary for germination. Therefore, regulating the environment, especially the RH, is essential for preventing the deterioration of a museum collection from microorganism growth.

RH levels should be routinely monitored. Spore germination is less likely to occur if RH is controlled between 45% and 55%, but RH should be kept below 65%. When RH levels rise above 65%, the use of portable

dehumidifiers will be necessary to reduce the moisture content of the air. A temperature between 18°C and 20°C (64°F to 68°F) should be targeted. These levels only decrease the potential of germination and growth; they do not eliminate it. Therefore, other factors, such as adequate air circulation should be maintained; a fan will help to increase circulation.

Problem environmental conditions that may contribute to higher humidity levels need to be corrected. Repair leaking pipes, gutters and downspouts, cracked windows, a problem roof, deteriorated brick, masonry pointing, or cracked walls.

It is also important to keep any area that houses museum collections clean and free of dust and dirt and organic debris that can nourish spores.

Silica gel and other buffers can help adjust RH conditions within a sealed space, such as in a storage cabinet or exhibit case. These buffers will absorb or release moisture into the surrounding atmosphere. The quantity of buffering material to place within the space must be customized for each situation and a conservator should be consulted for assistance in determining this need. It takes time, experience, and careful monitoring to ensure that the buffers are performing as intended. (See *NPS Museum Handbook*, Part I (Rev 9/90), Appendix I, for additional guidance on the use of silica gel.)

Treatment

Collections should be inspected regularly for signs of microorganism growth. If an object shows signs of infestation, the piece should be sealed in a polyethylene bag or enclosed in polyethylene sheeting to prevent the spread of spores to other objects. Remove the object to an isolated space where the RH can be lowered by running a dehumidifier.

A conservator should be contacted for assistance in dealing with the infested material. However, as a general procedure, vacuuming is appropriate

in most situations. The object should be removed from the polyethylene and the bag or sheeting discarded. The object should then be vacuumed using a vacuum cleaner which will not exhaust the spores back out into the room. A vacuum fitted with a HEPA filter is recommended; however, the water bath filter vacuum cleaner, such as the Rainbow™ brand vacuum, that many parks have been using, is acceptable for this purpose. Follow all precautions when vacuuming an object: use the lowest effective suction and protective screening. (See NPS *Museum Handbook*, Part I (Rev 9/90), Appendix K, for vacuuming procedures.) Wear disposable gloves when handling a contaminated object. Seal the vacuum cleaner bag, gloves and other contaminated materials in a plastic bag and dispose of them in the trash outside the building. Also dispose of storage materials, i.e., acid free box or tissue, that were used to store the object.

Chemical eradication of a microorganism infestation with a biocide capable of killing the growths may only be considered in consultation with the Regional Integrated Pest Management (IPM) Coordinator and the Regional Curator. A proposal for chemical use must be submitted and receive final approval from the Servicewide IPM Coordinator in Washington, D.C. See NPS *Museum Handbook*, Part I (Rev 9/90), Chapter 5, for guidance. Use must conform to all NPS and Environmental Protection Agency restrictions and guidelines. In addition, a conservator with a specialization in the specific materials to be treated should be consulted to review the potential effects of any chemical on the object.

Sources

UV lamps are available through hardware stores.

Silica gel is available from conservation and archival-quality material suppliers.

HEPA filter respirators and disposable gloves are available from laboratory supply companies, such as Lab Safety Supply, P.O. Box 1368, Janesville, WI 54547-1368, (800) 356-0783.

HEPA filter vacuum cleaners are available from laboratory supply companies, such as Lab Safety Supply, and from Nilfisk of America, 300 Technology Drive, Malvern, PA 19355, (213) 647-6420.

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Formerly issued as Conserve O Gram 3/6. Revised 1993.

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